Artificial Transmutation

Aim

- to explain how man made elements are formed

Notes

Artificial Transmutation - human made reactions in which a nucleus is bombarded with a high speed particle which causes the nucleus to emit a proton or neutron

- particle accelerators give charged particles enough energy to overcome electrostatic forces and penetrate the nucleus of an atom
- acceleration is accomplished by manipulation of electric and magnetic fields
- Importance - method by which human made elements are produced
- Example 1

$$^{249}_{98}Cf + {}^{15}_{7}N \rightarrow {}^{260}_{105}Db + 4\,{}^{1}_{0}n$$

  - A nitrogen nucleus is absorbed by californium and 4 neutrons are given off to form the element dubnium
    - absorption of a nitrogen by californium increases the mass by 15 from 249 to 264 and increases the atomic number by 7 from 98 to 105
    - loss of 4 neutrons decreases the mass by 4 from 264 to 260 but does not effect the atomic number
      - The element formed, number 105, is man made
- Example 2

$$^{27}_{13}Al + {}^{4}_{2}He \rightarrow {}^{30}_{15}P + {}^{1}_{0}n$$

  - aluminum absorbs an alpha particle and releases a neutron to form phosphorus
    - absorption of an alpha particle by aluminum increases the mass by 4 from 27 to 31 and increases the atomic number by 2 from 13 to 15
    - loss of a neutron reduces the mass by 1 from 31 to 30 but does not effect the atomic number

Answer the questions below by circling the number of the correct response

1. Which of the following statements is true with respect to the reaction below:

$$^{249}_{98}Cf + {}^{15}_{7}N \rightarrow {}^{260}_{105}Db + 4\,{}^{1}_{0}n$$

   (1) The formation of Db is a result of a chemical reaction between Cf and nitrogen in air
   (2) The formation of Db is a result of radioactive decay of Cf
   (3) The formation of Db is a result of a natural transmutation
   (4) The formation of Db is a result of an artificial transmutation

2. With what is aluminum bombarded in the reaction below to produce ^{30}P?

$$^{27}_{13}Al + ? \rightarrow {}^{30}_{15}P + {}^{1}_{0}n$$

   (1) alpha particle (3) positron
   (2) beta particle (4) ^{15}N

3. The change that is undergone by an atom of an element made radioactive by bombardment with high-energy protons is called
   (1) natural transmutation
   (2) artificial transmutation
   (3) natural decay
   (4) radioactive decay